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ABSTRACT

A case study compared web-based and classroom instruction. Subjects, 40 students enrolled in a Communication Technology and Change class, were divided by volunteers into an Internet section (16 students) and a regular classroom section (24 students.) Results indicated that in all cases the classroom section performed slightly better than the Internet section, but in no case did the differences achieve statistical significance. Findings suggest that web-based instruction is as effective as classroom instruction as far as grades are concerned, but if classroom discussion is important to learning then students did not receive the same quality of instruction. Suggestions for future web-based courses are included. (Contains 14 references and 3 tables of data; two appendixes presenting the Internet and computer use questionnaire and the distance learning response questionnaire are attached.) (SC)

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The Effectiveness of Web-Based Instruction: A Case Study

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

The effectiveness of Web based instruction: A case study

With the advent of the World Wide Web in 1993, more and more people are finding that they can shop, chat, search for information, send messages, etc. without leaving their homes. Not to be left out of the information revolution, colleges and universities have begun offering courses via the Internet.

These web-based courses follow a long history of experiments with distance learning. A more traditional format for distance learning is the "telecourse," a video-based course. Today's most innovative "telecourses" tend to be live and interactive (Biner et.al. 1996, Biner et.al. 1997, Falck et.al. 1997). A live, interactive "telecourse," however, requires that students congregate in one or more designated locales at a specified time.

Web-based courses allow students to complete the course work on a schedule they set for themselves. In this respect, the web-based course is most like the type of correspondence school course using printed packages of lectures and assignments. But web-based courses can incorporate some of the elements of a "telecourse" as well - such as interactivity and audio/video elements (though the latter are rare due to hardware constraints).

A consortium of community colleges in the United States created the Community College Distance Learning Network. This network is distributed nationally and includes courses offered via the Internet, video-based "telecourses," and combinations of the two. ("Community Colleges..." 1998). The newly formed Florida Gulf Coast University was designed and built as a testing ground for Internet-based distance Learning ("FGCU Faculty..." 1998). And Jones

International University, which specializes in selling Internet-based courses for profit, is the first Internet-only school to be accredited to grant college degrees. ("Online University..." 1999).

But how well are these Internet or web-based courses working? Faculty at Florida Gulf Coast University expressed some dissatisfaction with web-based courses in a recent survey. They complain that web-based courses require extra effort to teach, due to voluminous e-mail correspondence with students. They also have reservations about the appropriateness of using the Internet to teach courses requiring hands-on training. Questions of copyright also arise in the case of syllabi and lectures posted on the Internet. ("FGCU Faculty..." 1998). Despite these concerns and others, efforts go forward to evaluate and design the "best" web-based courses (Bosher et.al. 1997).

If web-based instruction is the pedagogical equivalent of classroom instruction we can predict:

Hypothesis: There will be no significant difference in student performance in a web-based instructional environment versus a classroom-based instructional environment.

The study reported herein records a case study comparing web-based and classroom instruction.

Methodology

Forty students enrolled in the class, Communication Technology & Change were divided into two groups. One group received the course via classroom instruction, the other group received the course over the Internet. Because this was a graded course, ethics required that students not be randomly assigned to conditions in the experiment. Instead, volunteers were requested for the Internet section. Sixteen students (11 males, 5 females) volunteered to participate in the Internet section leaving 24 students (14 males, 10 females) in the traditional

classroom setting.

All students enrolled in the web-based section were required to subscribe to a class listserve. Written lectures were placed on the Internet. The lectures included the following: images and graphics, links to other Internet sites for further reading, discussion questions that were linked to the listserve via the "mailto" command. Students in the classroom section did not have access to either the listserve or the posted lectures. Students in both sections took exams in the classroom at the same time.

Results

Because students were not randomly assigned to sections, efforts were made to discover if the students in the two sections had similar traits. All students in the class were given the following scales prior to the separation of the class into the two sections. A 2-way analysis of variance using instructional section and gender as independent variables was performed for each scale. No significant interactions were observed between instructional section and gender for any of the dependent variables.

1. Personal Report of Communication Apprehension (PRCA-24) (Beatty, 1994) In addition to allowing students to set their own learning pace, web-based environments give students the opportunity to avoid contact with other students. This scale was given to see if students opting for the distance learning section might be more apprehensive of interacting with other students. The ANOVA tests indicated that the Internet group was significantly more apprehensive than the classroom group (see Table 1).
2. Verbal Aggressiveness Scale (Rubin, 1994) Persons communicating via Internet chat rooms, listserves, Usenet groups and email have a reputation for being more aggressive in

their speech than is usual in face-to-face communication (Dyson 1997). This scale was given to see if those opting for the Internet condition were more verbally aggressive than those opting to remain in the classroom. No significant differences were found between the two groups on this scale (see Table 1).

3. Computer Apprehension Scale (Gressard and Loyd, 1985) Students opting for the Internet section would have to access lectures, ask and answer questions, etc. via computers. It seemed likely that students with high levels of computer "phobia" would be unlikely to opt for web-based instruction. The Computer Apprehension Scale measures Anxiety, Confidence and Liking for computers. The ANOVA test on this scale indicated that students opting to remain in the classroom had significantly higher levels of computer anxiety (see Table 1) and that females were significantly more apprehensive than were males (see Table 2).

4. An Inventory of Computer and Internet Usage (see appendix) As with the previous scale, it seemed likely that students opting for the web-based environment would have had more experience with computers and the Internet. An inventory of computer and Internet activities was given. Students opting for the Internet section had engaged in significantly more general computer activities than the classroom section, but there was no significant difference in prior Internet usage. (See Table 1)

If web-based instruction is an adequate substitute for classroom instruction, then student performance on graded assignments should not differ. A 2-way Analysis of Variance was performed using Instructional section and gender as independent variables and mid-term and final exam grades (both tests combined multiple choice and essay questions) and the final grade point

average for the course (GPA reflected exam grades, web page assignments and Internet exercises)as dependent variables. No significant interactions were found between instructional condition and gender. Females had significantly higher overall GPA's than did males but there were no significant differences between males and females in mid-term and final exam scores. (See Table 2) In all cases the classroom section performed slightly better than the Internet section, but in no case did the differences achieve statistical significance. (See Table 1) At least as far as graded assignments are concerned, taking the class via the Internet did not seem to affect performance either for the better or for the worse.

The Computer Apprehension Scale was given to students again at the end of the semester to see if experience with computers in the course would affect student attitudes toward computers. Recall that prior to the beginning of the course, the classroom section was significantly more apprehensive of computers. At the end of the semester this difference had disappeared and there was no longer any significant difference in computer apprehension between the two sections. However, a closer examination of pre- and post-test computer apprehension scores indicates that this was achieved by lowering apprehension scores among the classroom section and increasing apprehension scores among the Internet section! (see Table 1)

At the end of the semester, students in the Internet section were asked to fill out a questionnaire (see appendix) asking about their experiences with web-based instruction. No significant differences due to gender were discovered. Students who reported accessing the class lectures once a week or more often had significantly higher GPA's and final exam grades. (See Table 3)

While GPA and mid-term exam grades were also significantly related to frequency of

contact with the instructor via email, no logical pattern emerges. Students seemed to perform better if they had either greater than usual contact or less than usual contact with the instructor. (See Table 3)

Students who either printed out all of the lectures or none of the lectures performed better overall than those who printed out only some of the lectures (See Table 3).

Students who reported problems printing out the lectures performed significantly better on the mid-term exam than those who reported no problems. (See Table 3)

Students who reported that their lecture notes were better than they usually take earned significantly higher GPA's than those who reported their lecture notes were the same as usual. (See Table 3).

Conclusions

Was web-based instruction as effective as classroom instruction? The answer is a qualified, "yes." Yes, as far as all the graded assignments in the course were concerned. No significant differences were found between the two groups in regard to mid-term and final exam grades or in overall grade point averages for the course.

Nevertheless, the Internet students did not utilize the listserve adequately. On only three occasions throughout the entire 15 week semester did students actually respond to comments made by other students on the listserve. All other listserve activity was composed of students giving very short answers to questions posed by the instructor that were built in to the lectures or responding to questions posed by the instructor that were posted on the listserve.

Two problems came to light regarding the use of the listserve. First, students were not keeping up with the lectures. One student might respond to a particular lecture's questions during

the week they were supposed to be reading that lecture, while other students would respond to the same question two or three weeks later. It is difficult for students to discuss the content of a week's lecture on the listserve if they are not reading the same lecture at the same time. Secondly, many students did not use the listserve at all during the semester. Discussions are impossible if students refuse to participate.

From a pedagogical point of view, it is hard to conclude that the students taking the course via the Internet received the same quality of instruction as those in the classroom. If classroom discussion is important to learning, then they clearly did not.

Nevertheless, all Internet students who filled out the final questionnaire (two managed to avoid it) indicated that they would like to take more classes via the Internet. The general impression given by the students was that they really didn't care about classroom interaction and just wanted to earn the credits and get the grades. Only one student in the Internet section indicated dissatisfaction with the course. And his complaint was that his fellow students would not respond to his listserve postings. (His postings were the only ones that ran longer than a short paragraph - he tended to fill pages). He clearly wanted someone to argue with him, and the instructor was the only one who would.

Suggestions for future web-based courses

The following suggestions are offered based on experience with the case study reported herein. Caution should be used in enacting these suggestions as the sample size in the case study was very small and students were allowed to self-select which instructional section they wished to take. Future research is needed in this area to confirm the findings.

Regarding Posting Lectures on the Internet

1. Lectures/syllabi should be posed behind a "firewall" to prevent people who are not enrolled in the course from accessing these materials. Far too many colleges and universities are attempting to make money off web-based instruction these days. Professors should not "give away" their work.

2. Lectures should include opportunities for students to respond to posted materials. This can be achieved by placing discussion questions in the lectures linked via the "mailto" command to the listserve.

3. Lectures should include appropriate design elements to make them both attractive and interesting - but - design cannot take the place of substance. Above all, the content of the course should be challenging and thought-provoking.

4. Care should be taken to proofread all posted materials for spelling/grammar, and references for lecture material should be posted.

5. Avoid the temptation to add audio/video elements to your lectures. Students will be accessing lectures through a wide variety of computer hardware, telephone and cable modems. Design for the lowest level of equipment. Assume your students are operating with an old 486 and a slow telephone modem. Do not assume multi-media capability.

Regarding Student Class Participation

1. Students will probably need to be "encouraged" to participate in listserve discussions. You might try counting listserve activity as a part of a class-participation grade. Be prepared to send students a report every other week on how satisfactory their listserve performance is.

2. In order to "encourage" students to keep up with the rest of the class in their reading and

participation in listserve discussions, build in regular graded assignments with **firm** due dates. Such assignments could take the form of essays based on reading assignments.

3. Chat rooms are not recommended. One of the advantages of web-based instruction is that students can take the course on their own daily schedule. Trying to get everyone together in a chat room at a particular time would be a logistical nightmare.

Testing

Students in this case study took tests in the classroom regardless of which instructional section they were in. Other arrangements would have to be made for a course offered exclusively over the Internet. Such arrangements can typically be made with local colleges/universities, public libraries, etc. Or you could design "take-home" style tests.

A Final Thought

Don't let the school administration talk you into letting the enrollment in web-based courses climb to astronomical levels. These courses **do** take more time and effort to teach. You can't "wing" web lectures! All materials must be carefully prepared and designed in advance. You will have to answer the same questions over and over again for students who refuse to access the listserve on a regular basis. And you will have to build in additional graded assignments to encourage students to keep up with their reading and discussion that would not be necessary in a classroom setting. Administrators have a nasty habit of basing course enrollment on available seating. Imagine their excitement when they realize that a web-based course can have, in theory, unlimited enrollment. Take a firm stand on course enrollment right from the start!

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Table 1

ANOVAs of Group by Dependent Variables

Dependent Variables Range	Group	Mean/ Standard Deviation	F-ratio degrees of freedom	Significance
General Computer Use 0(low) - 13(high)	In-Class	7.3333/ 2.7767	17.878	.000*
	Internet	10.6250/ 1.7078	1,38	
Internet Activity 0(low) -20(high)	In-Class	5.1667/ 4.4883	3.357	.075
	Internet	7.8750/ 4.7170	1,38	
Computer Apprehension Pretest/Posttest Difference	In-Class	3.3333/ 8.7510	6.418	.016*
	Internet	-4.7143/ 10.5643	1,36	
Computer Apprehension Pretest 30(low)-150(high)	In-Class	72.0000/ 19.9695	6.142	.018*
	Internet	57.8750/ 13.3610	1,38	
Computer Apprehension Posttest 30(low)-150(high)	In-Class	69.5000/ 23.6036	.251	.620
	Internet	66.2857/ 4.8267	1,36	
Grade Point Average for Class	In-Class	3.0383/ .5534	1.320	.258
	Internet	2.8271/ .5344	1,36	
Communication Apprehension 6(low) - 30(high)	In-Class	19.7292/ 4.7290	6.150	.018*
	Internet	23.3594/ 4.2219	1,38	
Mid-term Exam	In-Class	.6767/ .08052	2.458	.125
	Internet	.6250/ .1231	1,38	
Final Exam	In-Class	.8483/ 0.8052	.861	.359
	Internet	.8213/ .1039	1,38	
Verbal Aggression Scale 20(low) - 100(high)	In-Class	43.2500/ 10.9157	.895	.350
	Internet	46.2500/ 7.8613	1,38	

* statistically significant at $\leq .05$

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Table 2

ANOVAs of Sex by Dependent Variables

Dependent Variables Range	Sex	Mean/ Standard Deviation	F-ratio degrees of freedom	Significance
General Computer Use 0-13	Male	8.9231/ 3.2115	.659	.422
	Female	8.1429/ 2.1788	1,38	
Internet Activity 0-20	Male	6.6154/ 4.8256	.439	.511
	Female	5.5714/ 4.6029	1,38	
Computer Apprehension Pretest/Posttest Difference	Male	-2.4167/ 10.2699	5.547	.024*
	Female	5.1429/ 8.1037	1,36	
Computer Apprehension Pretest 30-150	Male	60.4615/ 15.8120	8.748	.005*
	Female	77.2857/ 19.4913	1,38	
Computer Apprehension Posttest	Male	65.2500/ 16.8736	1.750	.194
	Female	73.5714/ 21.5682	1,36	
Grade Point Average for Class	Male	2.8117/ .5621	5.353	.027*
	Female	3.2157/ .4333	1,36	
Communication Apprehension 6-30	Male	21.5769/ 5.1627	.493	.487
	Female	20.4464/ 4.2087	1,38	
Mid-term Exam	Male	.6492/ .08993	.309	.581
	Female	.6686/ .1290	1,38	
Final Exam	Male	.8454/ .08453	.560	.459
	Female	.8229/ .1018	1,38	
Verbal Aggression Scale 20-100	Male	44.3846/ 7.5423	.003	.955
	Female	44.5714/ 13.3918	1,38	

* statistically significant at $\leq .05$

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Table 3

Statistically Significant ANOVAs

Independent Variables	**Dependent Variables**	**Mean/ Standard Deviation**	**F-ratio degrees of freedom**	**Significance**
Access Lectures	Grade Point Average		9.202	.007*
twice a week/more		2.9275/ .4007	2,9	
once a week		3.1000/ .0000		
once a month		1.8000/ .0000		
Access Lectures	Final Exam		5.626	.021*
twice a week/more		.8075/ .09896	2,11	
once a week		.9600/ .0000		
once a month		.7300/ .01155		
Communicate with Instructor via email	Grade Point Average		10.524	.004*
same as usual		2.3600/ .4429	2,9	
more than usual		2.9950/ .1212		
less than usual		3.5400/ .0000		
Communicate with Instructor via email	Mid-term Exam		10.035	.003*
same as usual		.5100/ .1084	2,11	
more than usual		.6500/ .01155		
less than usual		.7500/ .08083		
Print Out Lectures	Grade Point Average		16.705	.001*
yes, all of them		3.0675/ .3221	2,9	
yes, some of them		1.8000/ .0000		
no		2.5400/ .0000		
Problems Printing Lectures	Mid-term Exam		6.640	.028*
yes		.7400/.0 9238	1,10	
no		.5575/ .1243		
Quality of Lecture Notes	Grade Point Average		1,10	.001*
same as usual		1.8000/ .0000		
better than usual		2.9620/ .3608		

* statistically significant at $\leq .05$

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Appendix

A. Internet and Computer Use Questionnaire

B. Distance Learning Response Questionnaire

A

IUS

Instructions: This survey is concerned with your experience using computers and the internet. There are no right or wrong answers.

1. Have you ever used Windows?

   a. yes
   b. no (skip to question #3)

2. Check off each of the following Windows procedures with which you are familiar:

   _____opening files on the hard and floppy drives (usually C and A drives)

   _____saving files on the hard and floppy drives

   _____deleting files in File Manager

   _____creating files/directories in File Manager

   _____moving/copying files in File Manager

   _____installing new software

   _____writing text in a word processing program

   _____editing text (cutting/pasting/moving/sizing. etc) in a word processing program

   _____printing from a word processing program

   _____creating tables in a word processing program

   _____creating figures in a word processing program

   _____using SPSS for windows

   _____using an image editor

3. Do you have a Zip-Net account?

   a. yes
   b. no

4. Have you ever surfed the Internet?

   a. yes
   b. no (this ends the survey for you. Don't worry. By the end of the semester you will have done most of the things this survey asks about!)

5. Do you surf the Internet from a Mac based system or a Windows based system?

   a. Mac
   b. Windows
   c. other (specify_____)

6. How do you access the Internet? check all that apply

   _____through a lab computer at the University

   _____from my home computer via modem to the University

   _____from my home computer via modem to a commercial service (such as AOL, CompuServe, etc.)

   _____from my home computer via a high speed cable modem (such as Time-Warner Cable's Roadrunner)

   _____other (specify_____)

7. Which Web Browsers have you used? Check all that apply.

   _____Netscape Navigator (regular or gold)

   _____Microsoft Internet Explorer

   _____ NCSA Mosaic

   _____Lynx

   _____ Mac Web/ Win Web

   _____InternetWorks

   _____Other (specify_____)

6. Which Internet activities have you participated in? Check all that apply.

   _____exchanged e-mail

   _____attached files to e-mail messages

   _____received and read files attached to e-mail messages

   _____subscribed to listserve groups

   _____participated actively in listserve discussions

   _____read usenet discussions

   _____subscribed to usenet groups

   _____participated actively in usenet discussions

   _____used an internet search engine (such as Yahoo)

_____bookmarked internet addresses for later reference

_____created your own page using an HTML editor (such as Netscape Gold or Microsoft Internet Assistant)

_____created your own page using HTML Language

_____downloaded software from the internet

_____downloaded gif or jpg files from the internet

_____purchased products advertised on the internet

_____printed out information found on Web pages

_____saved on disc information found on Web pages

_____downloaded, unzipped and read zipped files from the internet

_____visited chat-rooms

_____actively participated in chat-room discussions

_____other

(specify_____

_____

_____)

7. Do you consider yourself:

a. an expert Net Surfer
b. a pretty good Net Surfer
c. a mediocre Net Surfer
d. a newbie Net Surfer

B

Distance Learning Response Sheet Name_____

Lectures

1. How often did you access the lectures?

   a. twice a week or more
   b. once a week
   c. several times a month
   d. once a month
   e. less than once a month

2. Did you print out the lectures?

   a. yes, all of them
   b. yes, most of them
   c. yes, some of them
   d. no *(skip to question 4)*

3. Did you experience any problems printing the lectures?

   a. yes
   b. no

4. Did you download/save the lectures on disk or in your personal computer's hard drive?

   a. yes, all of them
   b. yes, most of them
   c. yes, some of them
   d. no

5. Did you access the lectures from on-campus computer labs?

   a. all of the time
   b. most of the time
   c. some of the time
   d. never (go to question 7)

6. Did you experience any problems using the on-campus computer labs? *(check as many as apply)*

   a. I had problems getting access to a machine (too crowded)
   b. I had problems with computer viruses
   c. I had problems with malfunctioning machines (not due to viruses)
   d. I had problems with the "help desk" people not knowing the answers to my questions
   e. other (specify)

7. Compare your experience with the on-line lectures to taking lecture notes in classes: Would you say the on-line computer lectures were: (choose one response from each group)

Group 7a

a. **no better/no worse** than the lecture notes I usually take in classes
b. **better** than the lecture notes I usually take in classes
c. **worse** than lecture notes I usually take in classes

Group 7b

a. I found the on-line lectures **no more or less** interesting than in-class lectures usually are
b. I found the on-line lectures **more** interesting than in-class lectures usually are
c. I found the on-line lectures **less** interesting than in-class lectures usually are

8. What did you like **most** about the on-line lectures?

9. What did you like **least** about the on-line lectures?

Listserve

10. Do you feel the Listserve allowed you to participate in class?

a. I participated through the listserve **about as much** as I usually participate in classes
b. I participated through the listserve **more** than I usually participate in classes
c. I participated through the listserve **less** than I usually participate in classes

11. What did you like **most** about the Listserve?

12. What did you like **least** about the listserve?

Email

13. How do you feel about using email to communicate with the instructor?

a. I talked with the instructor via email **about as often** as I usually talk with my instructors
b. I talked with the instructor via email **more** often than I usually talk with my instructors
c. I talked with the instructor via email **less** often than I usually talk with my instructors

14. What did you like **most** about using email to communicate with the instructor?

15. What did you like least about using email to communicate with the instructor?

16. Would you like the opportunity to take more classes via distance learning (using the internet, listserves and email)

a. yes, I probably would
b. no, I probably would not

17. Why/why not?

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